Section: Radiology

Original Research Article

MAGNETIC RESONANCE IMAGING ASSESSMENT OF CENTRAL NERVOUS SYSTEM DEMYELINATING DISORDERS: A PROSPECTIVE 3TESLA STUDY OF SIXTY PATIENTS

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ABSTRACT

Background: Inflammatory demyelinating disorders of the central nervous system are a major source of neurological morbidity. Accurate distinction among multiple sclerosis (MS), neuromyelitisoptica spectrum disorder (NMOSD), and acute disseminated encephalomyelitis (ADEM) is essential because management strategies and long-term outcomes differ considerably. Magnetic resonance imaging (MRI) plays a pivotal role in early detection and disease characterization. The objective is to determine the diagnostic utility of MRI in identifying, classifying, and monitoring demyelinating brain diseases. **Materials and Methods:** This prospective observational study included 60 consecutive patients clinically suspected of demyelinating disease. All subjects underwent standardized brain and, when required, spinal cord imaging on a 3-Tesla MRI scanner. Lesion distribution, morphology, contrast enhancement, optic nerve involvement, and interval changes on follow-up examinations were systematically analyzed. **Result:** MS accounted for the majority of cases (66.1%), followed by NMOSD (18.6%) and ADEM (10.2%). Periventricular and juxtacortical plaques predominated in MS, whereas longitudinally extensive spinal cord lesions were frequently encountered in NMOSD (63.6%). ADEM demonstrated large confluent lesions with complete radiological resolution. New lesion development was most common in MS (74.2%), while lesion persistence was typical of NMOSD. **Conclusion:** MRI provides reliable differentiation of demyelinating disorders based on lesion topography and temporal evolution, thereby facilitating appropriate therapeutic decisions and prognostication.

INTRODUCTION

Demyelinating diseases of the central nervous system arise from immune-mediated injury to myelin, leading to impaired neural transmission and diverse neurological deficits. Among these disorders, multiple sclerosis, neuromyelitisoptica spectrum disorder, and acute disseminated encephalomyelitis are encountered most frequently in clinical practice. Because clinical manifestations often overlap, imaging plays a decisive role in establishing the diagnosis.[1-6]

Magnetic resonance imaging has become indispensable owing to its excellent soft-tissue contrast and sensitivity to white matter abnormalities. In addition to detecting lesions at an early stage, MRI assists in assessing disease burden, monitoring progression, and evaluating therapeutic response. Specific imaging patterns—such as periventricular plaques in MS or longitudinally extensive spinal cord lesions in NMOSD—provide valuable diagnostic clues.[7-12]

The present study was designed to systematically evaluate MRI findings in patients with suspected demyelinating disorders and to determine the usefulness of imaging characteristics in differentiating various etiologies.[13-15]

Aims and Objectives

- To assess the role of MRI in early detection of demyelinating disorders
- To analyze lesion location and disease extent

- To describe morphological and enhancement characteristics
- To distinguish MS, NMOSD, and ADEM using imaging features
- To evaluate radiological changes during follow-upMaterials and Methods

Prospective observational study conducted over 2.5 years in a tertiary center. Sixty patients were imaged on a 3T MRI using T1, T2, FLAIR, DWI, and post contrast sequences. Lesion characteristics and follow up changes were recorded.

MATERIALS AND METHODS

Study Design and Setting: A prospective observational investigation was carried out in the radiodiagnosis department of a tertiary care center.
Study Period: September 2022 to March 2025.
Participants: Sixty patients with clinical suspicion and MRI evidence of demyelinating pathology were enrolled after informed consent.
Inclusion Criteria

- Neurological symptoms suggestive of demyelination
- MRI features compatible with white matter disease

Exclusion Criteria

- Vascular, infectious, or metabolic mimics

Imaging Protocol

All examinations were performed on a 3-Tesla system using:

- T1-weighted sequences (pre- and post-contrast)
- T2-weighted imaging
- FLAIR
- Diffusion-weighted imaging
- Spinal cord sequences when clinically indicated

Parameters Recorded

- Lesion topography
- Size and configuration
- Contrast enhancement
- Spinal cord and optic nerve involvement
- Follow-up evolution

Statistical Analysis: Findings were summarized as frequencies and percentages and displayed using tables.

RESULTS

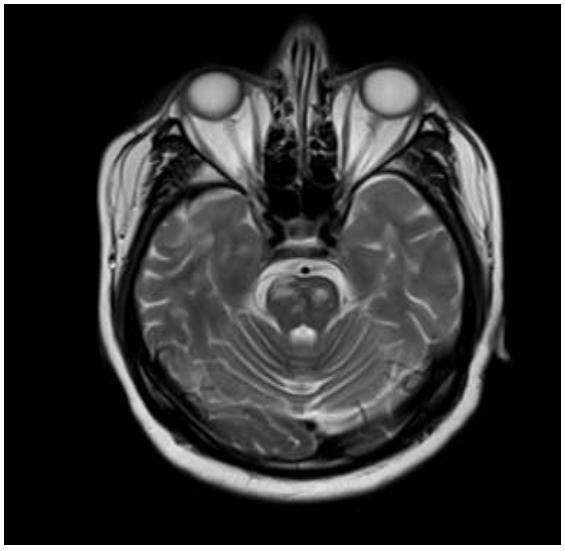
Table 1: Distribution of Diagnoses

Disease	Number	Percentage
Multiple sclerosis	39	66.1%
NMOSD	11	18.6%
ADEM	6	10.2%
Others	4	5.1%

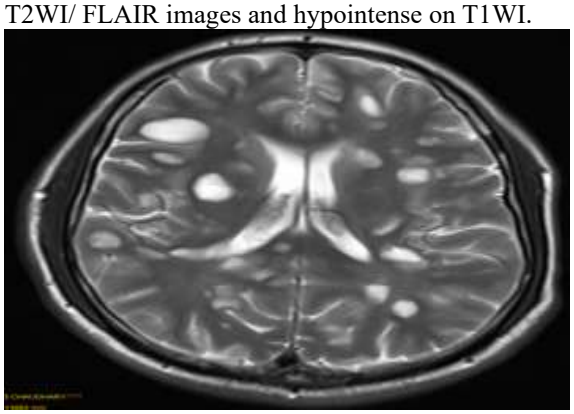
Demographic Profile: The majority of patients were between 31 and 60 years of age. A female predominance was noted in cases of multiple sclerosis and NMOSD.

Table 2:Lesion Localization

Region	MS	NMOSD	ADEM
Periventricular	69%	45%	83%
Juxtacortical	46%	9%	50%
Brainstem	5%	9%	50%



Multiple ill defined altered signal intensity plaques involving pons which appears hyperintense on T2WI/ FLAIR images and hypointense on T1WI.



Multiple well defined varying sized round to oval T2WI/FLAIR hyperintense lesions noted involving periventricular deep and subcortical white matter of bilateral cerebral hemisphere, bilateral thalami,

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bilateral ganglio-capsular and callososeptal interface and shows peripheral incomplete ring contrast enhancement. No evidence of any diffusion restriction or GRE blooming.

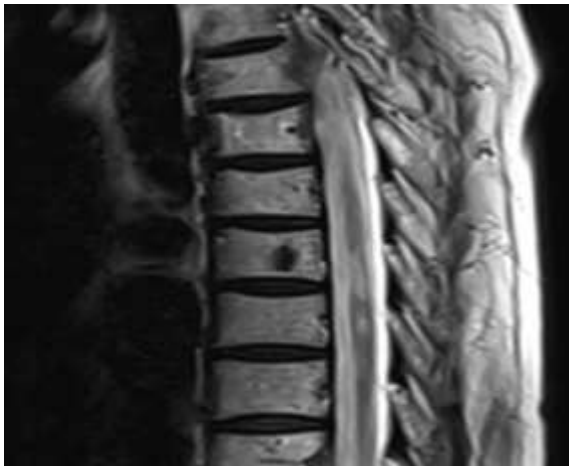
Signal Characteristics

- T2/FLAIR hyperintense lesions were identified in all patients.
- Post-contrast enhancement was observed in 30.8% of MS, 36.4% of NMOSD, and 16.7% of ADEM cases.
- T1 hypointense areas were present in most patients.

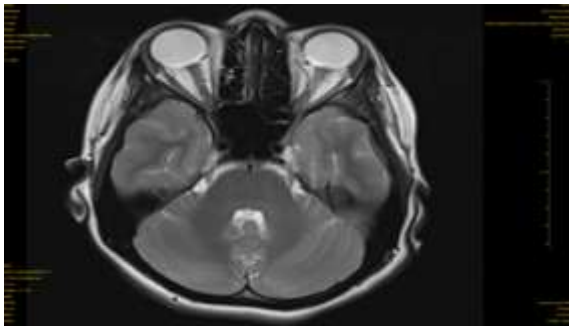
Table 3: Spinal Cord Findings

Feature	MS	NMOSD	ADEM
Cord involvement	35.9%	72.7%	33.3%
Long-segment lesions	2.6%	63.6%	60%

Short segmental abnormal T2WI intramedullary hyperintensity at the level of D7 & D8 vertebra which shows post-contrast enhancement.



Optic Nerve Abnormalities: Optic nerve involvement was most frequently observed in NMOSD (63.6%) and was comparatively less common in MS and ADEM.



Intra-orbital,intracanalicular and intracranial part of left optic nerve appears bulky with adjacent fat stranding, abnormal T2WI/ FLAIR hyperintensity and shows areas of diffusion restriction within it.

Follow-up Observations: New plaque formation was predominantly seen in multiple sclerosis. ADEM demonstrated complete lesion resolution on follow-up, whereas NMOSD lesions showed a tendency to persist.

DISCUSSION

This prospective evaluation reinforces the central role of MRI in the assessment of demyelinating disorders. MS represented the predominant diagnosis, with classical periventricular and juxtacortical plaques consistent with established diagnostic criteria. Frequent emergence of new lesions during follow-up reflects the relapsing nature of the disease.[16]

In contrast, NMOSD demonstrated a strong association with extensive spinal cord involvement and optic neuritis. The persistence of lesions in this group may explain the comparatively worse clinical outcomes. ADEM, however, showed large but reversible lesions, supporting its monophasic inflammatory course.[17]

Thus, analysis of lesion distribution and evolution enables reliable differentiation among these conditions. Early radiological identification facilitates appropriate immunomodulatory therapy and improves prognosis.

Limitations

- Single institutional study
- Relatively small cohort
- Absence of advanced quantitative MRI techniques
- Limited long-term follow-up

CONCLUSION

MRI remains the most effective imaging tool for diagnosing and monitoring demyelinating brain disorders. Characteristic lesion patterns permit differentiation among MS, NMOSD, and ADEM, allowing timely and targeted management.

Summary: In this cohort of sixty patients, multiple sclerosis was the most frequent demyelinating disorder. Distinct MRI signatures, particularly lesion location and longitudinal changes, enabled accurate disease classification. MRI continues to be indispensable for diagnosis and follow-up in demyelinating pathology.

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